points of discussion that a reader would naturally suggest are considered by him exactly where the discussion is wanted, and it will be very easy to criticise the work in the light of any further developments which may arise at the hands of future investigators.

In extending the notion of entropy to radiation, he is working on the lines best calculated to advance our knowledge of thermodynamic phenomena. When a system is in the course of undergoing an irreversible transformation, the entropy at any instant is a definite quantity, provided that at that instant it is possible to conceive a reversible compensating transformation which would bring the system back to its initial state, and also that a definite line can be drawn between the forms of energy that are to be regarded as available and unavailable. In the case of radiation, it is important to push the notion of entropy as far as it will go. Only when this has been done, and the results compared with those of experiment, will it be possible to say whether any limitations exist in the statement that perpetual motion of the second kind is impossible; but the vague and indefinite statements that have hitherto been made regarding the possibility of such motion have mostly been based on the consideration of processes which, when performed cyclically, involve considerable absorption of available energy, and the prospects of obtaining perpetual availability from the ether in *ordinary* cases of radiation are anything but hopeful.

G. H. BRYAN.

ELEMENTARY BOTANY.

(1) *A Text-book of Botany.* By John M. Coulter. Pp. vii+365. (London: S. Appleton, 1906.) Price 5*s.* net.

(2) *A First Course in Practical Botany.* By G. F. Scott Elliot. Pp. viii+344. (London: Blackie and Son, 1906.) Price 3*s.* 6*d.*

(3) *First Studies of Plant Life.* By G. F. Atkinson. Edited for use in English Schools by Miss E. M. Wood. Pp. xiv+266. (Boston and London: Ginn and Co., 1905.) Price 2*s.* 6*d.*

(4) *A Text-book of Botany.* Part i. The Anatomy of Flowering Plants. By M. Yates. Pp. v+147. (London: Whittaker and Co., 1906.) Price 2*s.* 6*d.* net.

(1) INFLUENCED, it may be, by one's early training, it has always seemed most reasonable to begin an elementary course of botany with morphology, working in so soon as convenient the explanation of form and structure in the light of purpose served, an arrangement that is adopted by Prof. Coulter in his text-book.

The nature and modifications of leaf, stem, and root are first considered, after which the student is directed to the study of unicellular organisms, then to the examination of types of increasing complexity selected from the main taxonomic groups. The summaries of these groups have been carefully prepared, the account of the fungi being specially comprehensive yet brief. Following on the Bryophyta and ferns, a brief sketch of the two generations of the horsetails and lycopods leads up to the phanerogams. The lessons on flowers and fruits are introduced with the angiosperms, and ecology receives due recognition in the last few chapters.

As the book is liberally supplied with illustrations, chosen with much forethought, it is observable that Prof. Coulter has brought his extensive survey within a remarkably small compass. The merit of the book lies in the judicious selection of essential facts and principles. The numerous references to economic plants constitute a novel feature that is most noticeable in the chapters on the classification of phanerogams. There would be little or no objection to offer if the author made the most of their botanical characters, but these are omitted, and only commercial facts are given, occupying space that would be better filled with botanical information.

Apart from this adverse criticism the book deserves high commendation, and is admirably suited to its purpose for use in secondary schools.

(2) The practical course drawn up by Mr. Scott Elliot presents a somewhat unusual arrangement, inasmuch as the experiments are grouped on a morphological basis; this has, it is true, some advantages, but not sufficient to prefer it to the more usual physiological disposition.

A considerable amount of space is devoted to the flower, as, in addition to one or two chapters, full descriptions of two or more flowers are appended to each day's work. The practice of giving students, when time is available, a few flowers each day is excellent, but it seems unnecessary to provide detailed descriptions of all of them; further, the sequence—if there is a sequence—is not suitable to beginners. The theoretical discussions preceding, but not always relevant to, the practical work are also long, and curtail the space that is allotted to the actual experiments. The experiments, numbering nearly a hundred, are fairly representative, although the fundamental experiments of transpiration, respiration, and osmosis are not so satisfactory or complete as one could have wished. A sufficient amount of anatomical work is included, and a useful bibliography is appended referring the student to accounts of original investigations.

(3) Among the many elementary books dealing with plant life, the studies by Prof. G. F. Atkinson, published about four years ago, have a freshness and vitality of their own. The numerous references to American plants that are not known in this country robbed the book of much of its value for use in schools in the United Kingdom. This defect has been remedied by the introduction of British types, also, we note, of British expressions. Excellent as were the original drawings and photographs, the substitutes prepared by Miss Wood and Dr. J. W. Ellis are quite up to the same standard.

(4) The small volume prepared by Miss Yates is on the lines of the German "Repetitorium," and presents a collection of morphological definitions and terms with illustrations. In the course of thirteen chapters the author collates the different organs of flowering plants, their modifications, and the scientific terms

© 1906 Nature Publishing Group

used to denote special features. The list of terms is very complete, and includes a few, *e.g.* "marcescent," "fovilla," and "sobole," that would not have been missed. A few of the definitions, notably those of the seed and leaf, might be more accurately expressed, and among misprints one of the most noticeable is "aetoeris" for "etaerio"; but on the whole the author has done her work well, and the book should prove useful.

THE PHOTOGRAPHY OF COLOUR.

Natural-colour Photography. By Dr. E. König. Translated from the German, with additions, by E. J. Wall. Pp. 94. (London: Dawbarn and Ward, Ltd., n.d.)

Colour-correct Photography. By T. Thorne Baker. Pp. 95. (London: Dawbarn and Ward, Ltd., 1906.) Price 1*s*. net.

THE first of these volumes deals with the reproduction of colour and the second with the representation of coloured objects in black and white or monochrome.

Towards the end of the first volume we read that "colour photography is not a purely mechanical copying of nature, carried out with mathematical precision, and that, indeed, it will never be. He who works quite automatically will never advance." The statement as to the present is certainly true, and the prophecy, though bold, is, literally, justifiable so far as experience goes. The reproduction of colour is thus essentially different from the representation of form, for this latter depends only on the perfection of one's instruments and a commonly intelligent use of them. Colour photography, as at present practicable, may be described as a kind of simplified chromolithography, inasmuch as the choice of colours rests with the worker or those who provide him with materials, and the depth of tint depends on the worker's judgment. Its distribution is mechanical, but, again, this depends on the colour-screens or filters used in the photography, which are never more than approximately what they are desired to be. And when it is remarked that the colours used are none of them permanent in the sense in which carbon or platinum is permanent, it is obvious that, so far as the colour goes, colour photography does not furnish more trustworthy records than painting or any other colour-production method, except, perhaps, that the possible errors of the unskilful may be a little more limited.

At the same time, there are certain principles which, if they could be perfectly applied, would give perfect colour reproduction. Remarkably fine work has been done by those who have adhered as closely as possible to these principles, as well as by those who have trusted chiefly to empirical methods. The volume before us is a small one; it merely mentions the underlying principles, being devoted almost entirely to the practical details of the "subtractive method" of three-colour photography, that is, where the three coloured prints are superposed so that their absorptions are added, and to the "additive method," in which the three colours themselves are added to each other, as when they are separately projected by optical means on to the same screen, or united in the eye itself by means of mirrors. That the two methods are not so radically different as they might at first appear to be is obvious from the fact that, to a certain extent, the colour-screens used are interchangeable. We think that a little more of the theoretical basis would have made the practical details more understandable. Spectrum diagrams of the effects of the various colour-filters might have been given, and, in dealing with three-colour work, some confusion might have been avoided by omitting the reference to yellow as a fundamental colour, thus giving four colours instead of three to deal with. We are astonished to read at p. 47 that "it is a recognised fact that photography always reproduces shadows much too dark." It would have been better to blame the photographer for this rather common error than apparently to justify him by suggesting that he is helpless.

As to the scope of the volume, photo-mechanical methods are altogether and designedly excluded, as the book professes to appeal to amateurs and others who are photographers, but not to commercial printers. The direct processes such as Lippmann's, and those in which the colour work is practically done by the maker of the materials, are only shortly referred to in the introduction. As a practical guide to the working of those methods that are now generally available for amateurs the volume will be found very useful, as it gives formulæ for the various colour-filters and dyes for staining, quite practical instructions for making the filters and other apparatus, and deals systematically with the subject.

Mr. Thorne Baker's volume is more than the title indicates, for he gives a chapter on the representation of colours incorrectly, as may be sometimes desirable for distinguishing emphatically between two or more colours. To get a coloured flashlight that will shorten the exposure by increasing the brilliancy of the colours to which the plate is less sensitive, he recommends to mix magnesium powder with a twentieth to a fortieth part of a mixture of equal weights of calcium and lithium carbonates. The author gives much other useful information in the ten chapters that deal with the various branches of the subject. We do not see, however, why the exposure should be shortened when the studio blinds are coloured instead of using a coloured screen as usual, nor why metol should be "*not* recommended" as a developer. Such advice would be more acceptable if the reasons for it were given. The explanation given at p. 85 of the fact that "the exposure required with cells of different thickness does not vary directly as their width" is incorrect; it is not a matter of absorption by the glass sides of the cell, but of the selective absorption by the coloured liquid. But the book as a whole forms a useful introduction to the subject, and contains some formulæ and suggestions rarely met with.

C. J.

© 1906 Nature Publishing Group